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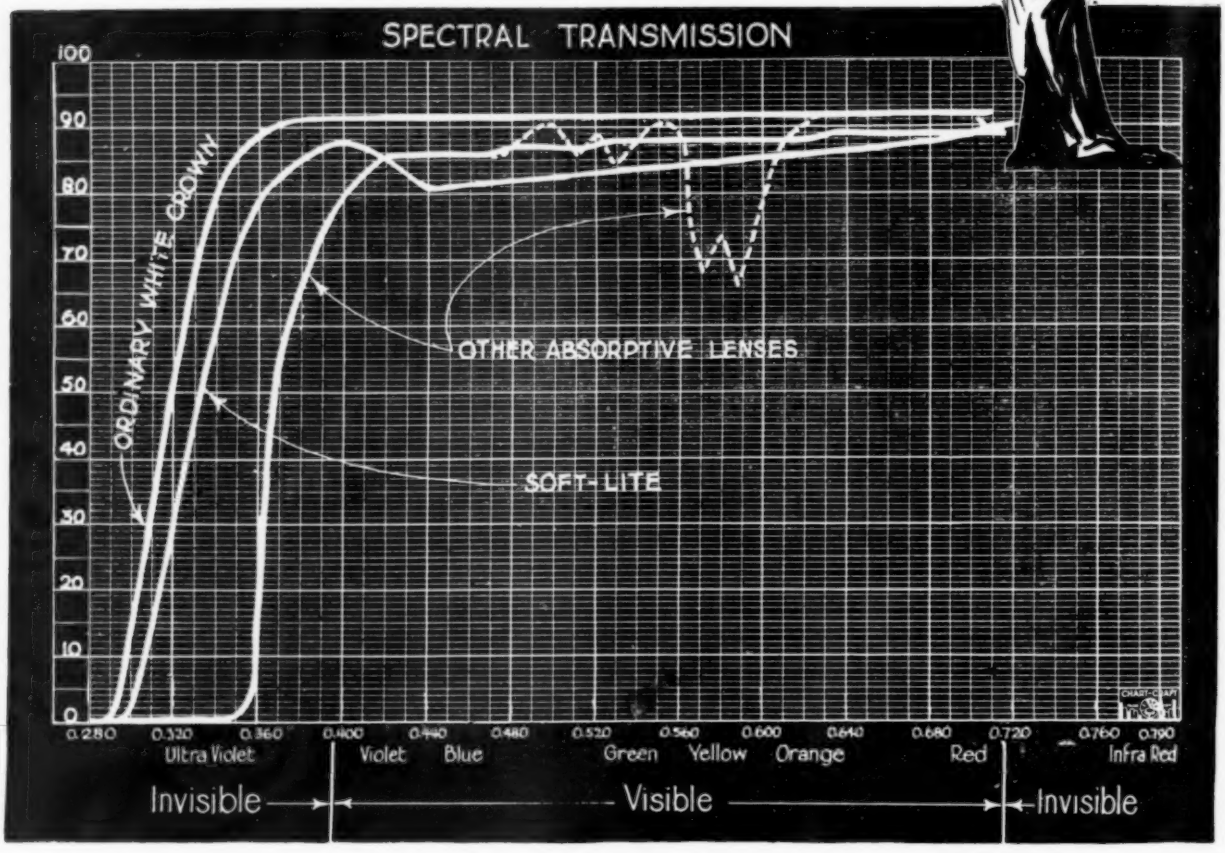

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NON-OPERATIVE TREATMENT OF STRABISMUS*

R. M. Hall, A. B., B. Sc., F. A. A. O.
Cleveland, Ohio

In presenting this paper to the Academy at this time, I do so with the greatest of foreboding. Not from fear of contradiction or from fear of disrupting someone's personal philosophy, but because of a question arising in my own mind as to whether the time is yet opportune for the descent from the clouds to a plane of reality. For the past ten years our practitioners have been running thither and yon, trying this technique, that instrument, this nobody's theory, and that somebody's philosophy, ever trying to find a panacea for the problem of non-operative squint correction and if it were not for the change of attitude of our literature in the past two years, I would hesitate even now to puncture the bubble. Not that I condemn individual research, for I know only too well that only by research, trial and error do we advance, but I do believe, and sincerely, that enough unco-ordinated work has been done and it is time that a definite line of procedure should be laid down. Not that the outline which I wish to lay before this group be accepted, but that this paper will, at least, be a start in the right direction.

It is high time that we come to the realization that the child with a squint is not a normal patient. He comes to us neither on a mental par or a physical par with a normal child. He is assuredly a problem case, and the sooner we come to this realization and stop trying to find some magical hocus-pocus which will correct the difficulty for us, the sooner will we have made a definite step forward in the elimination of squint.

As it is true that squinters are certainly not up to standard physically or mentally, it is also true that the squint in itself is often a symptom of some underlying physical or mental condition. Especially is this true in those cases of psychic squint in which there is a definite carry-over from early sex life.

On the other hand, the converse of this is true, that the squint is in itself the basic factor in the production of the increased nerve tension

*An abridgement of the material presented before the American Academy of Optometry at Baltimore, December 17th, 1933.

of the patient. The majority of convergent squinters are of a high-strung, neurotic type—always on the go—"driving mother to distraction," and yet we see the restlessness disappear and the nervousness decrease when once binocular vision has been re-established. True, too, from the psychological aspect, for when the squint (infantile trauma) has been removed the patient can again raise his head and face the world without a fear or a sense of inferiority.

The problem then resolves itself into the determination and construction of a fundamental working procedure, not one of individual instrumental technique necessarily, but a basic plan of action.

Not only should the optometrist be able to distinguish those cases which are in need of constitutional treatment, but he must be able to differentiate between operative and non-operative cases and also those in which the assistance of a psychoanalyst is needed. Then our first major problem is one of diagnosis and to this end we turn.

There are five or six major steps which must be taken before any judgment can be rendered as to the type of squint and what its treatment shall be:

1. History.
2. Observation and Inspection
3. Tests (Screen and Corneal Image).
4. Quantitative (Measurements).
5. Refraction.
6. Fusion Tests (Both Qualitative and Quantitative).

It seems then, that if these various steps be industriously carried out in every case, the diagnosis would become more nearly correct.

The taking of a history in a squint case is not the simple procedure that it would seem upon the first thought; instead, it requires time and patience and a subtleness upon the part of the diagnostician which is not necessary in the ordinary office examination. In the first place, we are seeking the existence of facts which to the patient are relatively unimportant and consequently his memory of them is vague. We are primarily interested in the *age of onset* of the disturbance, length of time in existence, the circumstances surrounding its first appearance, the mode —whether it was occasional or constant (of diagnostic value in that we judge that a squint which was at one time intermittent is more amenable to treatment). Also contributing factors such as: fright, traumatism, the presence of specific fevers, etc. We then are interested in the periods of the disturbances, whether the squint has a definite time occurrence (as every day at three o'clock), if it occurs previous to the child's nap or upon awakening, whether it becomes worse when he is tired, etc. All these factors and more are of inestimable value in the eventual dispensation of the case. Most of the answers must be elicited from the parents, however, if the patient is old enough, much information may be gained from him by thorough questioning. Heredity plays a most important part and its connection must be included in every care-

ful examination. Too, it is necessary to know of the conditions at birth, whether normal or whether instruments were necessary. Of prime importance, too, is the knowledge of what efforts have previously been made toward the relief of the disfigurement—operation, treatment or spectacles.

From this resume of the data obtainable, it can readily be seen that the importance of taking a detailed history cannot be overestimated.

Now, then, our second step is that of preliminary inspection and observation. The notations of the apparent conditions existing, namely, apparent domination of one eye over the other, the aperture of the palpebral fissures, the presence or absence of ptosis, of corneal scars, indications of old keratitis, the presence of post-operative scar tissue on the sclera. We must note, too, facial characteristics, formation of the head and the relationship of the orbits, scars on the external margins of the orbits (indications of the use of forceps at birth), bulbophthalmus, etc. Under observation, we note head tilting and other tendencies which the patient uses to get relief and to conceal his disfigurement (hesitation of looking up due to self-consciousness—more prominent in female patients). We must observe, too, the physical characteristics of the patient, whether he is of a high-strung nervous, quick-acting type or the slow-minded, slow-moving, plodding type (over-convergence and convergent squint is usually associated with the former type, while the latter type are prone to excessive divergencies). We note also the attitude of the patient in his desire to please the doctor and care must be taken, for if the child is of this type the putting of the questions in the remainder of the examination must be handled skillfully, for this class, in their desire to please are apt to try to answer the questions in a way in which they think the doctor desires it to be, in other words, they anticipate the desired answer and give it; as a result, the examiner must be constantly on his guard. At this point it is well to take written note of the hand-eye relationship of the patient, for it is of prime importance in the eventual treatment of the case.

Testing for Pathology:

It becomes more and more apparent as the work goes on in the treatment of strabismus, that more of the cases handled have a definite pathological background, therefore it becomes necessary to exercise every precaution in the elimination of all pathology, either acute or chronic, before any non-operative treatment can be instituted. The optometrist has at his command three factors which he may use in the determination of any existing pathology, namely, observation and inspection, the ophthalmoscope and the perimeter.

First, under observation and inspection, should be noted inflammations (acute or chronic), corneal scars due to injury or keritits, and post-operative scar tissue. Inspection at this point should include also the appearance of the face, noting indications of congenital lues (radiat-

ing lines around the mouth, saddle bridge or Hutchinson teeth).

With the ophthalmoscope, we note things such as corneal scars, corneal opacities, cataract or lenticular opacities, opacities of the vitreous and in the main any peculiarities of the fundus, checking for hemorrhages, active or old choroiditis and any other disturbances which might affect vision.

With the perimeter or campimeter, we make a detailed study of the fields, both central and para-central. Color field studies should be made at this time, not only as an indication of existing pathology, but as a guide to the future development of the case. In studying the central and para-central areas, we are primarily interested in the presence or absence of scotoma. May it be advised that the smallest test targets, those of one-half degree or one degree, be used for para-central work, and that either the Haitz charts or a modified form of them be used in the plotting of the central fields. It can readily be seen that even the most minute scotoma, if lying close to the macular area, will cause a marked decrease in visual acuity. Too, it must be impressed that many original diagnoses of Amblyopia-Ex-Anopsia have had to be changed after a thorough central field study.

The Character of the Squint and Its Determination:

In the main, all lateral squints divide themselves into two wide classifications, namely, convergent and divergent. Each of these major classes into more characteristic types, for instance, in the following outline we see that:

A. Convergent (can be further classified into):
   1. Paralytic or comitant.
   2. Unilateral or bi-lateral.
   3. Periodic (occasional) or constant.
   4. Alternating.
      a. True (essential).
      b. False (accidental).
   5. Spurious or pseudo.

B. Divergent (can be further classified into):
   1. Paralytic or comitant.
   2. Unilateral or bi-lateral.
   3. Periodic (occasional) or constant.
   4. Alternating.
      a. True (essential).
      b. False (accidental).
   5. Neuropathic.

For the determination and classification of these various types many tests have been devised, most of which have proven of little or no value. However, several have withstood the pressure of time and repetition, and due to their simpleness and flexibility are certainly worthwhile detailing here.

From *simple inspection* we determine the presence of the deviation and also something of its character (as to whether it is unilateral or bi-lateral), but a more detailed study is necessary.

Cover or Screen Test:

The cover or screen test, as it is sometimes called, is probably the simplest and most frequently used check for 'phorias and tropias we have. While not accurate to a fineness, it is elastic and greatly facilitates the typing. The patient is instructed to fix the target, either at distance or near, the fixing eye is occluded with card or paper; if any deviation is present in the unoccluded eye, it must then deviate in or out to fix. If the redress is in, the squint is divergent; if out, convergent. If, however, the patient fixes the target with either eye separately without screening, the squint is alternating.

The Corneal Image Test:

With the patient seated directly in front of the operator, a light from the ophthalmoscope or retinoscope is directed into his eyes. The patient is told to fix the light source; the light is then flashed rapidly from one eye to the other, the operator noting the variation in position of the reflected images. In ordinary squints variation is about equal, but in squints of the paralytic type, the secondary deviation is the greater. Normally the images should appear about one to one and one-half mms. to the nasal side of the axis, however, care must be used in this test due to the variation of the angle gamma in high hypermetropias or myopias.

We have in the main, three methods at our disposal, which, if followed rigidly, will expose the presence or absence of a paralytic squint. The first, which is more or less a subjective technique, is the presence of a persistent diplopia. It is necessary that the examiner question the patient closely and minutely, calling his attention to different highly colored objects about the room, as the false image is often so faint as to be almost negligible. In older patients, the diplopia is a common complaint. In patients too young to speak, this method is useless. The second test, and probably the best for all classes of patients, is the version test. With one eye occluded at a time, the patient is told to follow the light or fixation object as the operator moves it from side to side and up and down. If the eye fails to follow the light and stops with a jerky motion, there is a paralysis or paresis on that side (which may include one or more muscles). There is one thing which must be watched carefully and that is the similarity between poor ocular rotation and paresis. In poor rotation, the eye must be coaxed, but will move slowly. The third, and the one which is more commonly used today, is the detection of an insistent diplopia under complimentary red and green lenses. The patient faces the white object, one eye being covered with a red lens, the other being covered with a green, which is complimentary to the red; as the object is moved from side to side the diplopia will increase or decrease, increasing on the

affected side. This method is useless on real young patients and necessitates the patient keeping his head perfectly still.

Periodic Squint:

For diagnosis of Periodic Squint, whether convergent or divergent, we depend almost entirely upon the case history, both from the close questioning of the parents and the patients themselves. It is the type most usually affected by ocular fatigue, especially the element of fusion or of reflex convergence (third grade convergence). There is generally no squint on arising in the morning but as the eyes tire the squint appears. Its manifestation is due in great part to the diminishing strength of the fusional reflex, oftimes in conjection with a slight amblyopia. These squints must not be confused with those of the accommodative type, where a latent or manifest hyperopia causes an over accommodation and consequent over-convergence at the near point. In the true sense of the word periodic or occasional squint is fusion apathy, or a temporary weakening of the negative fusional reserve.

Neuropathic Squints:

Worth gives us the classification of Neuropathic Divergent Strabismus, and we are certainly in need of some broad division into which to put those difficult cases of divergence which we find only too often. The divergence nearly always dates back to infancy. It may be constant or occasional, unilateral or alternating. There is scarcely any refractive error, although sometimes when the squint is of long standing, an amblyopia will be found. The deviation is constantly varying. Most of these individuals have enough dynamic convergence to bring both eyes into play at the near point but seem to lack the urge to use it. They are of a nervous, high-strung character and resent any reference to their deformity. In many of these cases, we get a history of epilepsy and insanity. In this class, too, must go those women who, after the menopause, become highly exophoric or tropic.

Parallelling this class but not in it, are those exotropias resulting from progressive myopia and blindness. Needless to say, operation is the only cure in these cases.

Alternating Squint:

In the main, we have two primary classifications of alternating, namely, those of Worth:

(a) Accidental—where the refractive error is the same in both eyes. If they remain without treatment, one usually becomes dominant and the squint becomes unilateral.

(b) Essential— where there is little or no refractive error and vision is perfect in both. However, there is a congenital adversity to fusion. Fusion training is of no avail as there is a total absence of the fusion centers.

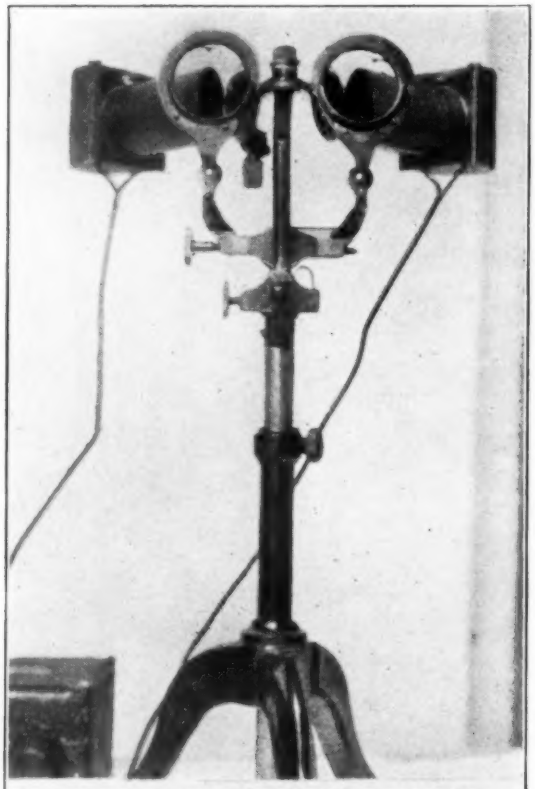
While it may be true that we have but two main types of alternating strabismus, our big problem is now to find some suitable method of differentiating between the two clinically, and also suitable instrumentation for treatment.

There is only one way which I know to differentiate between the two, and that is by the use of amblyoscope and by using the amblyoscope I mean to make a thorough, painstaking search of the case in order that we may gain a thorough knowledge of the fusion faculty. Simultaneously binocular vision usually can be elicited, in most alternating cases, by the production of our second object of regard beyond the angle of deviation. To be more explicit, in using the amblyoscope according to the commonly used technique, we first insert our targets in the holders and then adjust the angle of the mirrors to coincide with the angle of the squint, all the while questioning the patient as to whether he sees two objects (bird and the cage) at the same time. The errors of this method are obvious. In the first place, it takes a very intelligent patient to actually determine and express himself as to whether he sees the pictures simultaneously or not. Secondly, the operator must rely entirely upon what the patient tells him; in other words, the examination is entirely subjective.

If, however, we use a modified amblyoscope (one in which the observer can watch the eyes continually, see figures 1a and 1b, adjusting the mirrors to an angle greater than the actual deviation, then if the alternation is of the accidental type, the patient will observe the target of the right eye projected to his left and the target of the left eye projected to his right. He will see the two targets simultaneously and his statements can be readily checked by the observer, who, standing above and in front of the patient, can see that the binocular fixation is steady. However, if the mirrors are adjusted to the greatest angle possible, yet the eyes still alternate, the targets being projected to their relative sides, the alternation is then of the essential type. If this procedure is tried and the diagnosis of Essential is made, the prognosis is unfavorable. When results indicative of accidentally alternating squints are found, the prognosis is good, providing simultaneous binocular vision can be maintained until the angle of deviation is reduced to within six degrees of parallelism. When, upon trying to reduce the angle, the operator notices the re-occurrence of alternation before reaching the six degree limit, the prognosis is poor. Sometimes with coaxing, this type will come down to within those limits but even then the chance of 100% success is slight. In these tests single simultaneous binocular vision, though desired, is not essential, while inability to produce simultaneous binocular vision is failure.

The reasons for the use of the amblyoscope in making these determinations are:

a. Psycholgy.
b. Monocular control of target and illumination.
c. Monocular control of the angle of the mirrors.
d. Elimination of distortion due to prisms.



Dr R.M.Hall. Figure 1a.

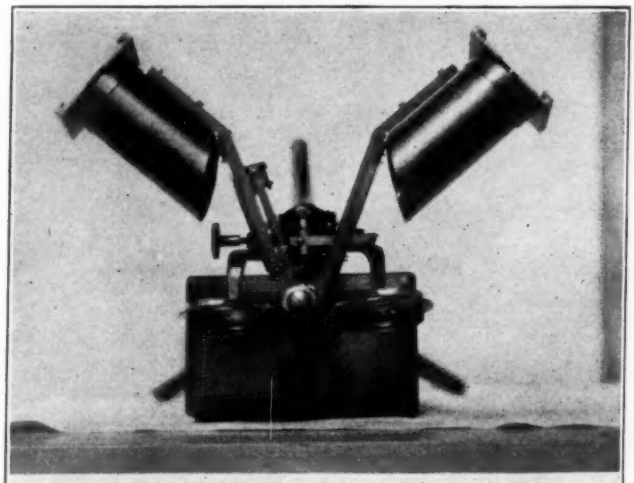
e. Maximum field of projection.
f. Ability of the operator to keep the patient's eye under constant observation.

Measurement of Strabismus:

Quoting Wilkinson, "The importance of an accurate determination of the degree of squint cannot be too strongly impressed" . . . "as an aid in determining the type and etiology of the squint and as a guide to future treatment."

The method suggested by Feinbloom in a report to the American Academy of Optometry in 1931 is ideal for clinical work and for those men specializing in this field, but for the average office practice, some more simple device is advised.

Lawrence's Strabismometer consists of a flat piece of ivory, concave on one side to fit the lower lid and scaled to the right and left of



Dr R.M.Hall. Figure 1b.

the center. The good eye is excluded and the squinting eye fixes, then the strabismometer is placed beneath it and the eye uncovered, the squinting eye again deviating, the degree of which can then be measured. The inaccuracy of this method is obvious.

Other methods have been devised by Hirschenberg, Javal, Charpentier, Maddox, Priestley Smith and others. The two methods of the most accuracy and the quickest to use are Maddox's Tangent Strabismometer and Priestley Smith's Tape. In using Maddox's method, the patient is placed facing the light at a meter distance and fixing on the tangent scale, the operator is seated facing the patient betwen him and the scale. Watching the corneal images, the operator points out the figures on the tangent scale and approximating the degree of the squint, tells the patient to look at that figure. If, when upon seeing it, there has been no additional movement, that is the true amount of the squint. Priestley Smith's method is approximately the same but more accurate.

The myoculator also proves the value in the measurement of strabismus. The patient is instructed to watch the projected target while the operator seated directly in front of him flashes the light from the ophthalmoscope in his eyes—as the fixing eye follows the moving target, the deviating eye gradually comes into line with the beam from the ophthalmoscope, when the corneal image is in the center of the pupil (considering the angle gamma), the moving target is stopped. The difference between the primary and secondary positions of the target is the angle of the squint in degrees.

Duane's method is probably the simplest and most effective of any. The procedure used is the same as that used in the screen test except that the trial frame is employed and prismatic power is added from the trial case until the redress is halted.

Checking of the Refraction:

Needless to say, any prolonged discussion of refractive procedure is unnecessary. I do wish, however, to call to your attention two or three points which I do believe are essential and which I believe are commonly overlooked or at least not sufficiently considered in the making of a refractive examination of a squint case.

First of all, we must have some method of taking an accurate record of the visual acuity, for it is here that we learn of the visual problem of the patient, the extent of the amblyopia, if present, and at least an indication of the patient's I. Q. Many methods have been devised, some of which are dependable, others which are a waste of effort.

a. The use of the ivory balls as designed by Worth. The balls of various sizes are rolled across the floor one at a time and the child is required to run and pick them up. His ability to go directly to the ball and the speed with which he recognizes its direction gives the examiner an idea as to his visual acuity. This test is obviously inaccurate.

b. The use of Snellen's test-types at distance or the modified form of using pictures in place of letters is of practical value. This test is much more accurate and most conducive to strict attention on the part of the patient.

c. The use of pictures of dogs, cats, dolls, etc. (things which are familiar to even the youngest patients), are drawn to scale and reproduced for the stereoscope. (Keystone.) This gives an accurate record, is rapid and convenient to use even in a small refracting room. Indication of the patient's I. Q. is gained by the number of pictures and letters he recognizes.

Secondly, the importance of taking the opthalmometer record cannot be over-estimated. While it is true that it is a difficult procedure and often must be checked several times, a knowledge of the true corneal astigmia is invaluable. In the very young, the taking of the ophthalmometer findings, of course, necessitates the aid of an assistant or in her absence, the parent may be pressed into service, to hold the patient firmly and to keep his interest centered upon imaginary happenings in the tube.

Thirdly, the major step in any refraction is that of retinoscopy. This should be checked carefully upon almost every visit of the patient. Many mechanical aids have been devised for obtaining constant fixation for retinoscopy, but probably the most ingenious is the "Jumping Jack" (Figure No. 2), designed by Dr. Henry of Akron, Ohio. This little device consists of a jumping jack operated by air pressure. The

patient controlling the pressure himself by manipulating the bulb attached to the instrument by a long rubber tube. Not only should the retinoscope be taken repeatedly at distance but also at near. It is essential that the total spherical and astigmatic errors be corrected at all times.

Fourth, the use of bifocals in many cases is of inestimable aid. Especially is this true in those occasional squints which have had their incipiency in an over-accommodative problem at the near point.

The *fifth* step is a re-check of the patient's visual acuity under the new prescription for now we learn of the degree of amblyopia and also gain insight as to its possible cause.

To differentiate between the two types of amblyopia (congenital or Ex-Anopsia) is difficult and probably, at the best, our methods are none too accurate. With the good eye occluded, we hold two similar targets before the deviating eye: if while the patient fixes on the one immediately in front of him and yet pronounces the one on either side to be seen more clearly, we judge that it is a case of Ex-Anopsia. But if both objects appear equally blurred, the diagnosis would be that

Dr R.M.Hall. Figure 2.

of Congenital Amblyopia. Care must be taken not to hold the secondary test object in line with the projected physiological scotoma.

There is little doubt but that the size and shape of the retinal images plays an important part in the cause of strabismus, but due to

necessity for binocular fixation in the determinations of the disparity between the two eyes, actual measurements are, at the present, impossible. However, the need to equalize still remains, and it is essential that even with the crude procedure we now use, that some attempt be made. At the best our only method at this time is purely a subjective one and at the most only partial results can be obtained, and then only in those patients intelligent enough to describe the variation in size and shape of the pictures under alternate occlusion.

So much for the correction of the refraction. Needless to say, it has been a hurried resume, but it would be utterly impossible to discuss this subject at any length in this paper.

Fusion Tests:

It is not the writer's desire at this time to enter any controversy as to whether the "Fusion Faculty" is congenital in its origin or whether it is an acquired habit; however, as the phenomenon of fusion is of physiological and psychological interest, a discussion of it is proper.

Quoting Adler, "In its highest development (binocular vision) the blending of the two images into one, results in the acquisition of a new quality of vision, i. e., stereopsis, which is impossible with either eye alone."

According to Worth, we have three grades of binocular vision, namely:

1. *Simultaneous macular perception*, in which grade, when two objects, either similar or dissimilar are presented to the maculae, the patient is aware of both, simultaneously.
2. *Fusion with amplitude*, in which grade, when two similar objects are presented to the maculae there is simultaneous recognition, followed by the blending of both objects into one and upon which there is then created a desire to retain the composite picture even against interference.
3. *Stereoscopic vision*, in which grade the images of the two eyes are blended into one with a resultant consciousness of the fullness, the solidity and the depth of the object viewed.

While it is true that our primary interest at this time is with the first of these, namely, that of simultaneous binocular perception, it is necessary that we have a working knowledge of the others before any type of treatment can be instituted.

Of the various tests for binocular vision and fusion which have been devised, we will limit our discussion to only those methods, which have proven most practical in a routine examination.

Testing for Simultaneous Perception:

In choosing a test for checking simultaneous perception, there must always be kept in mind the necessity of having absolute target control, in other words, always use a test which utilizes dissimilar targets. As

this test is almost entirely subjective, it is necessary for the operator to know exactly which image belongs to the right eye and which belongs to the left.

The use of the *complementary color test* as devised by Snellen and modified by others is as follows: With a pure red glass over the right eye and a green glass over the left, the patient is instructed to fix his attention on the screen in front of him. Onto the screen are then projected two dots, one red and one green. We now ask, "How many dots do you see?" If the answer is one red dot, the right eye only is being used: if the patient sees only the green dot, the left eye is being used: if the answer is two dots (one red and one green) diplopia (simultaneous binocular vision) is present. However, if the patient replies that there is but one dot and that, a greyish white, then he has first-grade binocular vision (single simultaneous perception).

The circle and square test is probably the most simple, yet most expedient of all. As used in the Telebinocular (Keystone), two cards are introduced into the card holder, one from the right, one from the left. On the right-hand card is a green square, on the left, a red circle. The cards are then moved back and forth until the patient is conscious of both targets. If, when the cards are at their normal separation (75 mms.) the patient says that the red circle is inside the green square, then first-grade perception exists. If, however, the patient is conscious of the presence of both targets but the circle appears to the right or left of the green square, we have diplopia with a corresponding 'phoria.

Testing for Amplitude (Quantitative):

Determination of the presence of an amplitude and also the amount is made most readily by the use of the Wells' Technique or by use of ordinary rotary prisms.

Wells' Method:

With the *Wells' stereo-optometer* in place and using the series E cards (plates, dishpans, etc.), the patient is instructed to watch the two plates as they approach each other. By varying the P.D. of the instrument, the operator is able to make the plates approach each other very slowly and at the same time he instructs the patient to tell him when the plates "jump into one;" now, if the readings of the instrument are taken and allowance made for the compensating prisms, the difference between the patient's P.D. and the point at which the targets fuse is the patient's amplitude, either positive or negative, in diopters. Stereoscopic vision is unnecessary in the making of these determinations.

The use of rotary prisms in measuring the amplitude of fusion is as follows: With the phorometer and reading rod adjusted, the patient is instructed to watch the target (circle or letter T). Prism base-out is introduced until the patient sees the target double: the prisms are then reduced and turned base-in, until the target doubles. The patient's amplitude is the total sum of the prisms, base-out and in.

Testing for Stereopsis (Qualitative):

Using slide number 33 of the Keystone Telebinocular set:

(a) "Ask the patient the relative position of the Jinrikisha carriage and the trees. He probably will reply that the carriage is closer to him than the trees.

(b) Ask the patient how many trees there are on the left side of the picture as you point directly to the two tree trunks which show. He probably will reply that he sees two trees."

Proof of Stereopsis gained by:

(a) "Slowly and evenly raising the flat picture No. 33 in front of No. 34.

(b) Again ask the patient the relative position of the carriage and the trees.

1. If the patient says that the carriage is now farther away than the trees, we know that at least to a fair degree, he sees stereoscopically.

(c) Again ask the patient how many trees he sees toward the left-hand side.

1. If the patient replies, 'I now see three trees,' this will prove stereopsis of a high degree. It requires better stereopsis to detect the separation of the trees than it does the correct position of the Jinrikisha."

Diagnosis:

It is imperative that before any plan for treatment can be outlined, that we have the correct diagnosis, not one of snap judgment, but one which is made after keeping the patient under observation for at least a month or more if necessary.

If we have made our observations carefully up to this point, we should be ready to make a differential diagnosis of the case in question.

First, we have determined whether it is convergent or divergent; secondly, whether it is unilateral or bi-lateral; thirdly, whether it is paralytic or comitant, if alternating we have decided into which class it falls. We have determined the degree of the squint, the type of amblyopia, if present and have gained some knowledge as to the fusional element and the refraction.

At this point our problem resolves itself into one of more minute differentiation, namely, whether the case lies solely within the field of Optometry or whether it should be referred to the ophthalmologist, the physician or the psychoanalyst.

If the squint is of the paralytic type and is of recent origin, it should be referred to the physician, for with the exception of the prescribing of relieving prisms, there is little, if anything, that the optometrist can do to benefit the patient.

Then, too, there are those cases which should be referred to the

psychoanalyst, but only after all question of pathology, physiology and mechanics have been eliminated. Needless to say, much time must necessarily be spent with these patients before the advisability of referring them for psychoanalytical treatment can be determined.

Our problem now narrows down to three main classes:

1. Those which are in need of surgical interference.
2. Those which are in need of surgical interference and post-operative orthoptics.
3. Those which are in need of immediate orthoptic training.

To the *first class* belong those cases of high lateral deviation (40 degrees or greater) which are complicated by a high vertical deviation (10 degrees or greater). Not that they cannot be corrected non-operatively but because of the time required upon the part of the optometrist and the necessary cost to the patient.

If the squint has been determined as belonging within the class of "Essentially Alternating Squint" it should be referred to the ophthalmologist; while the prognosis is poor in all squints of this type, there is always the slight possibility that the eyes will hold parallelism after an operation and at least gain aesthetic relief.

In this class, too, belong those squints of the Neuropathic Divergent type which are of long standing and associated with an amblyopia.

In the *second class* belong those cases of high lateral deviation (40 degrees or greater) in which the motility (checked by version tests) is too poor, as to preclude success by any non-operative procedure. If there is a doubt in the mind of the examiner, in cases of this instance, he has but to subject the patient to prolonged periods of treatment, using strong adverse prisms. In this class, too, belong those squints associated with true horizontal or rotatory nystagmus.

In the *third class* belong those squints of varying amounts, up to 40 or 50 degrees, which are occasional, constant or alternating, which are due to uncorrected ametropia; also those which have failed to obtain fusion, and those through unbalanced reciprocal innervation and tetanus have failed to develop good motility.

TREATMENT

The non-operative treatment of strabismus offers as interesting and complicated a problem as is met in any of the allied fields dealing with the human body. Not only is it a problem of mechanics but its roots lie deep in physiology, neurology and psychology. To say that the use of any one of these sciences, to the exclusion of the others, is sufficient, is not only gross ignorance but is inviting failure.

We have previously taken up in this paper a rather incomplete and hurried outline as to the methods of diagnosis and classification of squints. It is now time to turn our attention to the treatment.

We have at our disposal, at present, an ever increasing number of

techniques, so called, for use in orthoptic training. While the instrumentation of each is slightly different, the underlying principles are the same and though the end for which each strive is identical, to say that the end is arrived at by the use of any one of them, is probably untrue; but by the combined use of all, each doing that particular type of work, for which it has proven fit, non-operative treatment has unquestionably increased its effectiveness.

It must be thoroughly understood that there can be no rigid steps of procedure set down as to the treatment of any one particular case of strabismus. The treatment of any case depending entirely upon the circumstances met and the facilities with which the operator has to overcome them. However, we can roughly outline a general procedure which may be of some value:

1. Constitutional treatment.
2. Correction of gross ocular changes.
3. Correction of refraction.
4. Reduction of amblyopia.
5. Establishment of good ocular rotation and co-ordination.
6. Establishment of true projection.
7. Re-education of the fusion faculty.
8. Re-establishment of the fusional reserves.
9. Periodical re-examination of the patient.

Constitutional Treatment:

As previously pointed out in this paper, there are many physical conditions, the manifestation of which, we have observed in our preliminary examination, which are contributing factors to our case and which must be treated by the family physician or dentist before any definite procedure is started. Poor teeth, bad tonsils and general nervousness should all be properly taken care of.

Correction of Structural Conditions:

While this definitely does not come under the head of non-operative treatment, I do wish to impress the importance of first relieving by operation those squints of high degree, either convergent or divergent over 45 or 50 degrees, associated with a high vertical deviation.

Correction of the Refraction:

1. The total spherical and astigmatic error should be fully corrected at all times.
2. If necessary for full dynamic correction, make use of bifocals.
3. After fusion has been re-established, the use of adverse prisms, for constant wear, is advisable.

The Treatment Room:

At this time I wish to call your attention to an important factor in the treatment of squint, which is generally overlooked, or at the most, given very little consideration, and that is the treatment room, itself.

The room for this work does not have to be spacious, in fact too large a room only means unnecessary footsteps for the doctor or his assistant. It should be compact, not over 10 by 12 feet, and its walls painted a neutral shade. Its equipment should consist of one large treatment chair and two or three treatment stools. There should be one instrument for Strabismometry; the type is not essential. There should be either a perimeter or campimeter; at least two stereoscopes, preferably of the Telebinocular type; an instrument for the development of rotation (Myoculator, Squint Corrector or Wottring Normalizing Unit, etc.); an instrument for the development of hand and eye co-ordination (the Cheiroscope or Manuductor); an instrument to be used exclusively for the study of the fusion faculty (Amblyoscope or Stereoscope); an instrument for the use in re-establishing the reserves (Wells Head, Kratometer, Campimeter). One corner of the room should be reserved for a cabinet in which are kept sanitary chin rests, eye cups, towels, etc., the visual training cards (Pine-Wells-Krolls), field charts, a small index file for active patients and a dozen and one things which are needed in treatment work.

There should be numerous electrical outlets along its walls and baseboards and its illumination of a type easily controlled; it is preferable to use indirect lighting. It should be well ventilated, though soundproof. Its floor covering of linoleum to permit easy movement of instruments. The atmosphere of the room should be that of a quiet restful study, with no outside influences, which will tend to distract the patient's attention from the work at hand. Aside from the patient and doctor or his assistant, there should be no other person in the room, not even the parent or friend. Especially is this true in the handling of young patients, for the presence of the parent only acts as another object of attention. The attitude of the operator must be one of sympathetic yet enthusiastic co-operation. He must allow minutes for play and conversation but must always keep his hand directed toward the task to be done. He must never forget to comment upon the new dress, shoes or bracelet, yet he must never allow these to enter the conversation after the treatment is once begun. He should be equally free to praise or to scold. Truly he must be a good student of child psychology, knowing immediately when play should cease and work begin, in order that valuable minutes may not be lost.

Reduction of Amblyopia-Ex-Anopsia:

As long as there remains a question as to the etiological factors governing Amblyopia-Ex-Anopsia, so too, there will remain the improbability of finding a specific for its correction. We can rest the truth of this statement upon the reader's experience in his own practice; the treatment, which in one case is of the greatest stimulation, utterly fails to get response in the next. To a problem of this type, then, there remains but one solution and that is to try every known method and even some which are original on the part of the operator. True, indeed, the treatment of Amblyopia tests the ingenuity and skill of the worker.

Of the many treatments or techniques which have been originated for this work, a few are of real value and are worthy of discussion here.

The *use of Atropine* is of value only as a partial occlusion test. In the majority of cases it fails in its purpose and total occlusion must be resorted to.

Total Occlusion, by the use of gauze bandages or patches, is probably the most often used and while the simplest, it is most productive of results.

Suppression Lenses. The practice of over-correcting the dominant eye to a definite blur point has long been a favorite procedure. While the results have been fair, this method is impractical in those patients of school age.

Red Filters. The use of red filters as advocated by Peckham is of merit due mainly to a psychological effect. However, any tinted lens which reduces the vision of the dominant eye by 12% will be of sufficient disturbance to cause an occasional suppression in that eye.

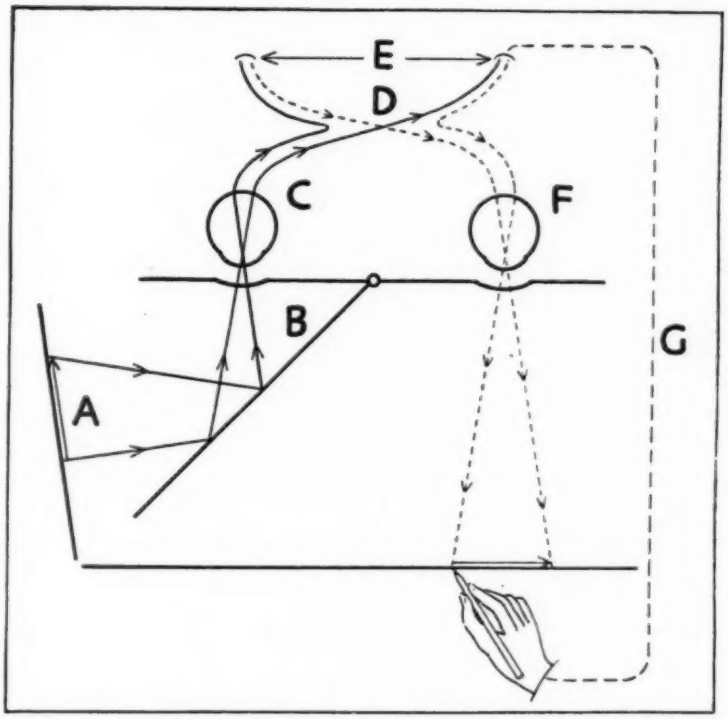
These four procedures, coming under the head of "Occlusion Methods," are probably the best of the many which have been devised for this purpose.

The use of *direct light stimulation* in the treatment of Amblyopia has come into popular use only within the past ten years. It is the writer's experience that direct stimulation is of little value, except in those cases where vision has been reduced to the counting of fingers at a one foot distance. The method is simple: A concentrated beam of light is projected directly into the eye; its exposure is varied by means of a mechanical flashing device and its color by various color filters. There apparently is no definite relationship between the intensity or duration of the stimulation and the percentage of visual increase. This technique is often varied by causing the light source to move in various directions, thus combining direct stimulation with rotation. Here again there is no proof of any relationship existing between the stimulation and the visual increase.

Co-ordinated Movements of Hand and Eye:

In recent years, Maddox has devised an ingenious instrument for use in reducing Amblyopia. The Cheiroscope, as Maddox calls the device, is used to re-educate the eye by co-ordinating its movements with those of the hand, his principle being, that form perception is originally developed by the sense of touch. Pictures or other targets, as stimuli, are exposed to the dominant eye. These stimuli are carried over the visual tracts to be projected by the other eye into space (in this instance onto a drawing platform); the hand is then brought into play to trace the outlines of the projected pictures (see Figure No. 3). Thus the desire for increased vision is stimulated.

Instruments, similar to that of Maddox, have been devised more recently (Peckham's "Manuductor" and Henry's "Maculovator")



Dr R.M.Hall. Figure 3. The Cheiroscope Mirror Action.

Showing how the active macular brain centers will stimulate and educate the corresponding sluggish macular brain areas and will combat any inclination towards suspenopsia. Again we have the hand that acts to lead the eye and to record the visual progress. A—Object. B—Mirror. C—Normal Eye. D—Chiasm. E—Visual Brain Centers. F—Amblyopic Eye. G—Impulse from Motor Brain Centers to Hand.

which, while less expensive and of more simple construction, are based upon the same principles.

There is little question but that this type of treatment aids greatly in the reduction of Amblyopia, having the advantages of controllable illumination and variation of stimulus, but the disadvantage, common to all, lies in the fact that the V. A. must first be brought up to a point where suppression is only an occasional factor.

Visual re-education, by the sense of touch, can be developed in countless ways; playing games which require co-ordinated hand and eye movement, coloring and cutting out pictures, jig-saw puzzles, sewing, etc., in fact any procedure which stimulates the attention factor.

Of 576 cases of squint examined by this writer in the past five years, 264 were Amblyopic.

Of the 264,

94 were pathological in origin.
36 were congenital.
134 were of the Ex-Anopsic type.

This latter group may be divided still further into the following classes:

V. A. of 20/200 or less	32
V. A. " 20/100	62
V. A. " 20/80	21
V. A. " 20/60	14
V. A. " 20/40	5

Of the class with V. A. of 20/200 or less:

those showing no improvement	6
" improving to 20/100	14
" " " 20/80	8
" " " 20/60	1
" " " 20/40	3
" " " 20/30	None
" " " 20/20	None

Of the class with V. A. of 20/100:

those showing no improvement	3
" improving to 20/80	12
" " " 20/60	27
" " " 20/40	19
" " " 20/30	None
" " " 20/20	1

Of the class with V. A. of 20/80:

those showing no improvement	3
" improving to 20/60	5
" " " 20/40	9
" " " 20/30	3
" " " 20/20	1

Of the class with V. A. of 20/60:

those showing no improvement	1
" improving to 20/40	8
" " " 20/30	4
" " " 20/20	1

Of the class with V. A. of 20/40:

those showing no improvement	3
" improving to 20/30	2

All methods of occlusion and treatment were tried in an effort to reduce the Amblyopia. The treatments were carried on over a period of

from six weeks to two years, with the following conclusions:

1. That approximately 35% of the Amblyopia associated with squint is pathological in origin.
2. That approximately 13% of the Amblyopia associated with squint is congenital.
3. That approximately 50% of the Amblyopia associated with squint of the Ex-Anopsia type.
4. That in at least 10% of Ex-Anopsia cases treatment is of no avail.
5. That if by constant occlusion over a period of six weeks visual acuity has not improved beyond 20/200, further treatment is contra-indicated.
6. That if by constant occlusion and direct light stimulation for over a period of 10 weeks, visual acuity is not improved beyond 20/100, further treatment is contra-indicated.
7. That if by combined use of occlusion, direct stimulation and other methods over a period of 12 weeks, visual acuity has not improved beyond 20/40, further treatment is contra-indicated.
8. That direct light stimulation is of no value in cases where vision is better than 20/100, in fact the converse is true.
9. That the attention factor varies inversely with the duration of the stimulus.
10. That Amblyopia, when associated with a squint in which motility is poor, is not a vital factor.
11. That the reduction of such an Amblyopia is not necessary for the elimination of the deviation.
12. That Amblyopia associated with a squint, in which there is good motility, is a vital factor and must be reduced before deviation can be corrected.

It might be of interest to note that of the 134 cases treated, only three improved to 20/20.

Establishment of Rotation of Co-ordination:

It is logical that in order to re-establish Rotation and Co-ordination it is preferable to make use of some type of moving target. The word rotation, in itself, implies movement and that is our main objective. We will not endeavor to discuss the theoretical background for this work but go at once into the instrumentation.

We have at our disposal at present three instruments which are ideal for this work, namely, the Myoculator, Arneson Squint Corrector, and the Wottring Normalizing Unit. While each of these instruments are similar in purpose, each has embodied in it certain advantages which the others lack.

The Myoculator:

This instrument is a moving projection latern, driven by a small motor and is capable of a rotary motion as well as vertical and horizontal. The projected pictures (dogs, men, etc., of interest to children) are produced in red and green and are controlled by the use of red and green lenses placed before the eyes (the red lens blocking out its compliment and vice versa). The principles are those of Snellen's "Color-Glass Test" but the modus is unique, in that the targets move in a plane perpendicular to the line of projection, thus while the angle of accommodation is held constant, considerable variation is obtained in the angle of convergence. Its value lies in its movement and its attention factor.

Arneson Squint Corrector:

This instrument consists of a large whirling disk. On one edge is mounted a small circular target, raised to give relief, with a small, red jeweled cataphote at the center. The target revolves in a plane perpendicular to the line of projection, thus keeping the angle of convergence constantly varying. Due to the color and design of its surface, it has a distinct advantage in the stimulation of an Amblyopia. While not the first instrument devised to make use of a rotary movement, it is probably the first to use the principles of adverse prisms in connection with rotation.

Wottring Normalizing Unit:

While similar in appearance and in principle to the Arneson Squint Corrector, this instrument is much more refined mechanically; its mcehanism allowing for uniform control of speed, variation in the intensity of target illumination as well as exposure, and automatic reversal. Its greatest advantage, and one which is not incorporated in the other instruments, is the ability to vary the movement plane of the target. For re-establishment of motility this is of definite benefit. Ocular control like that of the Squint Corrector is obtained by the use of prisms.

The *technique* used in these instruments, while possibly varying in detail, is primarily the same. The patient is seated before the instrument and instructed to watch the target. As the target revolves, base-in prisms (for convergent squint) or base-out prisms (for divergent squint) of increasing strengths are placed over each eye. The target, when first set in motion, rotates in a small circle. As muscular co-ordination occurs, the radius of the circle is gradually increased. In the Wottring instrument the plane of rotation may also be varied, thereby increasing the effectiveness.

The use of adverse prisms in squint correction is not new, but the method of combining them with a revolving target is worthy of commendation.

What has been said of these instruments for establishing rotation, holds good also for co-ordination, for if our theory of reciprocal inner-

vation is true and there is but little doubt remaining but that it is, then it certainly is logical that while the eyes are watching a target moving in almost every meridian, the angle of convergence constantly changing, then we are at least breaking down that resistance to smooth movement, which is almost always found in the strabismic eye.

Establishment of True Projection:

The instrumentation used in the re-establishment of the projection (the Cheiroscope, Kratoculator, Manuductor and Maculovator) is the same as that used in the reduction of Amblyopia (see treatment of

Dr R.M.Hall. The Wottring Normalizing Unit. Figure 4.

Amblyopia). Naturally there must be greater stress put upon this part of the treatment when there is a false projection existing. The establishment of true projection is a procedure which requires much time and patience upon the part of the operator for it is necessary to teach the patient, just as a teacher of piano teaches her pupil, new neural pathways.

Treatment of Alternating Strabismus:

The treatment problem of accidentally alternating strabismus is, indeed, an interesting one, and almost as many solutions have been offered for it as there are cases that alternate.

First, let us review the conditions which are found in this type. They are: equal visual acuity in either eye, with little or no refractive error present; equal visual acuity in either eye with a high refractive error about equal in each eye. Also, we are confronted by the rivalry existing between the fields of the two eyes, with the resultant, alternating, suppression, making it difficult to produce simultaneous binocular vision. Now, then, heretofore our principle method has been to introduce base-out prism (in convergency) to displace the line of projection to the macular area, in an effort to stimulate binocular perception, e. g., in Fig. No. 5.

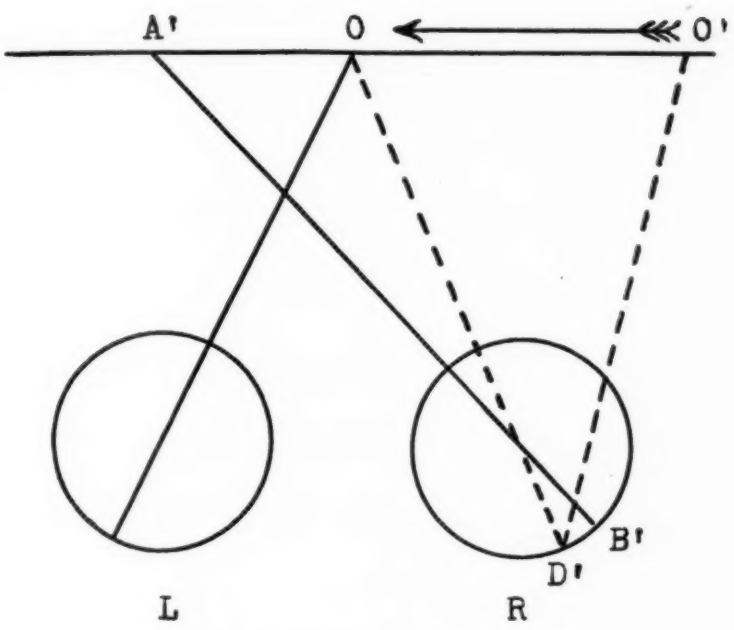
L is the non-deviating eye with its fixation on a target O, R is the temporarily deviating eye, with its visual axis along A′ B′. Then prism base-out is placed before R in an effort to displace its original line of projection O′ D′ to coincide with O D′ (O′ to O) and (D′ to B′), with the hope (and we might say a prayer), that simultaneous binocular perception will be stimulated.

Little need be said of this method; you may judge its success or failure from the experiences of your own practice.

Vertical prisms have also been tried with about the same percentage of failure.

However, let us go further, quoting Sheard in his discussion of fusional convergence, "When, however, the negative reflex convergence becomes fatigued, squint will occur, etc.," and continuing, "for strabismus will not occur when the amount of either positive or negative fusion convergence demanded, can be supplied and have, in addition, an adequate reserve." Certainly motility is of no consequence when dealing with alternation; then our problem is one of fusion, and primarily one of negative fusion, as by far the majority of alternaters are convergent.

Recently many writers and educators have been advocating the stimulation of the high fusional areas (that is the *positive*, in esophoria and the negative in exophoria) in training work, before trying to build up the low. Then why shouldn't this procedure be carried out in the treatment of alternating squint? It can be seen from Fig. No. 5 that we have been trying to stimulate the low area first.



Dr R.M.Hall. Figure 5.

Now, if this line of thought is carried further, we see in Fig. No. 6 the same relative position of the eyes as in Fig. No. 5, but here we are building a second object of regard, O′, outside the angle of deviation. Is it not more reasonable to believe then that the image of O′ falling within the high positive fusional area P, would find more receptability and less neutralization than the image of O which falls on the low negative area N?

This, then, is the exact nature of the method pursued in the use of the amblyoscope, advocated in preceding paragraphs of this paper. True, this same procedure may be made use of in the prism treatment (heretofore not enough base-out prism has been used to throw the image over into the positive area), but, as a great amount of prism power is necessary, accompanied by increased distortion, we reduce the possibilty of success by causing a disparity between our two retinal images.

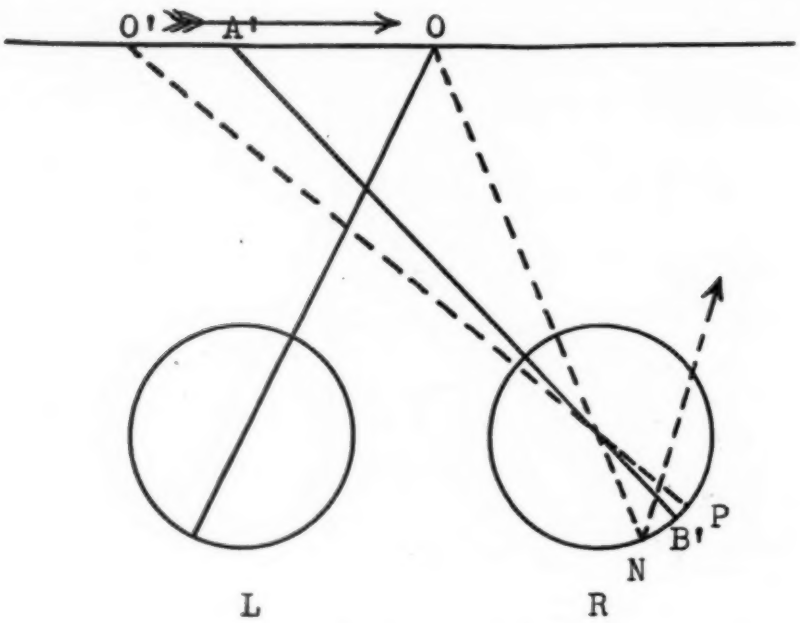
When simultaneous perception has been elicited, we can then go forward to reduce the stimulation on the positive areas and to gradually transfer it to the negative.

This can only be accomplished by slow, methodical work, urging the patient to constant attention, and watching the eyes continually for any faltering. It now becomes apparent why the modified amblyoscope (synaptoscope or synaptophore) is the more suitable for this purpose; we have no prismatic distortion, we have perfect illumination

and target control, and we can constantly observe the patient's eyes.

After good simultaneous binocular vision has been obtained within the limits of a central fusional area, not exceeding six degrees, the work is greatly facilitated by the use of other instrumentation, preferably some method by which we get a rotary movement over a small area.

The results of this method are indeed gratifying, for in many



Dr R.M.Hall. Figure 6.

cases, where the refraction is low, the squint can be entirely eliminated by the use of orthoptic treatment alone.

Re-education of the Fusion Faculty and Re-establishment of Reserves:

As previously stated elsewhere in this paper, we are not interested in the question of "Fusion" from a controversial standpoint, but because it involves interesting physiological and psychological problems of vital importance in the treatment of squint.

Any discussion of "Fusional Development" must, of necessity, be divided into three parts, namely:

1. Simultaneous binocular perception.
2. Fusion with amplitude.
3. Stereoscopic vision.

Simultaneous Binocular Perception:

In many cases, simultaneous binocular perception can only be regained by laborious effort on the part of both patient and doctor. It, like that of any other early training, requires constant repetition and attention. It is necessary that the doctor be with the patient through every training period, urging fixation and checking any tendency to suppression by increasing the stimulation before the non-dominant eye or decreasing that before the dominant. Those of you experienced in this work can readily appreciate the necessity of absolute target control; not only of illumination, but the type, size and color, as well.

The stereoscope, or some modified form of it, probably lends itself more readily to this type of work. In general, the procedure is usually the same: two dissimilar targets are put in the holder and by increasing or decreasing their separation, they are adjusted to nearly conform with the angle of deviation. Then the question is asked, "What do you see?"; the answer is usually, "the bird or the cage; the circle or the square." The eyes are then alternately occluded and the question repeated. If the answer is the same as before, the illumination on that particular target is decreased or a target of smaller size is substituted. Again the alternation of occlusion, etc., until the patient sees both targets simultaneously. Even then the work is not finished, for it must be continued until the targets are equalized as to size and intensity.

Development of Amplitude:

The development of amplitude or fusion reserve is relatively an easy matter, after once simultaneous perception is regained. Two methods of treatment have been advocated, namely: the shock system (as is made use of in the Kratometer, Cross's modification of the Wells' technique, the Campimeter, the Telebinocular "Eye Comfort" charts); and the force system (utilized in the Wells' technique and the Weitzenhof stereoscope). Either of these methods may be used to advantage; however, it is advisable to start the training with the smooth, even pull of the force method, in order to preclude any re-occurrence of the suppression. In this method, using the Weitzenhof Stereoscopic Attachment (see Fig. No. 7), or the Wottring Rotoscope, the targets are placed in such a position that they may readily be fused (here we have created a base-out prism effect by reducing the separation between the cards and are working within the limits of the positive fusion area); then, by means of a pulley arrangement, the targets are slowly and evenly drawn apart, thus reducing the base-out prism and increasing the base-in. When the target becomes doubled, the patient is instructed to close his eyes and the operator again reduces the separation of the targets nearly to their original position; the patient is then instructed to open his eyes and the process is repeated until it is no longer necessary to reduce the separation of the cards beyond normal to gain fusion.

After a workable amplitude has been built up under this method, the shock system may be resorted to. Here, as when using the Kratometer or Cross method, prism base-in is introduced by suddenly in-

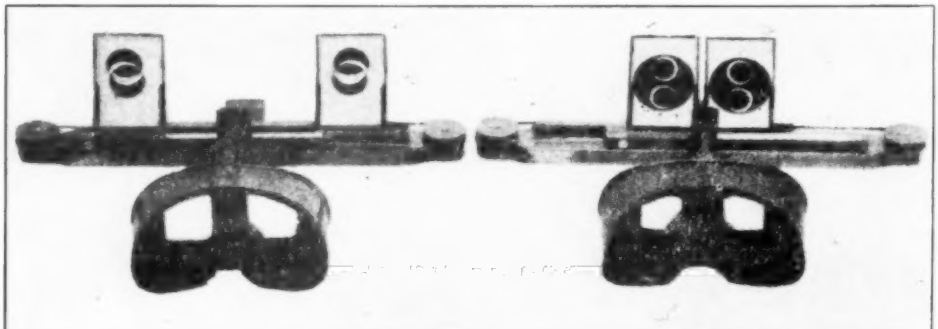
creasing the amounts. It is, as in other treatment work, advisable to first start with base-out prism (in convergency), reducing the amount of prism, by jumps, to zero and then building up the base-in by jumps of three, five and eight diopters.

Stereopsis:

The statement that stereopsis (the faculty of seeing solid) can be developed is, of course, open to question. Nevertheless, it is a proven fact that a patient can be educated to a better understanding of the difference which exists between flat surfaces and solids. This re-education may be brought about by the use of detailed stereograms or by simple targets drawn in third dimension.

The technique as suggested for the Telebinocular "consists of presenting the '1' series slides, in pairs, changing repeatedly, from the 'flat' to the 'solid' view slides, and suggesting that the one should look 'more real' or 'more solid' than the other." This is, of course, nothing more than pointing out to the patient something which has been in existence, but never recognized.

The method suggested by Wottring for the Rotoscope is to place simple pictures (dish pan, or saucer), drawn in third dimension, upon the turntable of the instrument and slowly revolve it, gradually increasing the separation. The operator can then ask the patient what change, if any, has taken place in the picture. In this way we get the patient's exact reaction, without suggestion.



Dr R.M.Hall. Figure 7. The Weitzenhof Stereoscopic Attachment.

Periodical Re-examination

When once the actual deviation has been eliminated and a sufficient amount of amplitude or reserve has been developed to enable the patient to hold binocular fixation, the doctor usually considers his job well done and, as a result, probably pats himself on the back and dis-

misses the patient. This is just what should not be done. The patient should be instructed that it is necessary for him to return every six months for re-examination and a definite appointment should be arranged before he leaves the office.

A suitable record card for squint re-examination should be kept; one, upon which special attention is given to the dynamic refraction, the 'phorias and the fusional reserves.

Periodical examinations, in this way, are made to serve two purposes, namely, retaining of the patient of the keeping of accurate records for future research work.

Resume of Findings:

A statistical review of 576 cases seen in the past five years might be of interest at this time.

Of these 576 cases, there were:

262 Males.
314 Females.

The females outnumbering the males in the ratio of approximately 3 to 2.

These patients ranged in age from 20 months to 26 years.

The average age of onset being 2 years 9 months.

The ages of onset in 246 cases of unilateral squint are tabled as follows:

Before 1 year	18
Between 1 and 2 years	29
Between 2 and 3 years	72
Between 3 and 4 years	54
Between 4 and 5 years	36
Between 5 and 6 years	17
After 6 years	20

The ages of onset in 78 cases of alternating squint are tabled as follows:

Before 1 year	8
Between 1 and 2 years	12
Between 2 and 3 years	23
Between 3 and 4 years	15
Between 4 and 5 years	14
Between 5 and 6 years	4
After 6 years	2

Of 536 cases, 198 give definite hereditary history. One family of squinters had four generations represented and three families each had three generations represented.

Of the 576 cases, convergency appeared as follows:

Convergency:

Constant in right eye	108
Constant in left eye	120
Occasional in right eye	18
Occasional in left eye	48
Alternating (Essential)	20
Alternating (Accidental)	50

Divergency appeared as follows:

Divergency:

Constant in right eye	22
Constant in left eye	38
Occasional in right eye	6
Occasional in left eye	8
Alternating (Essential)	22
Alternating (Accidental)	22

The expectancy of convergent squint to divergent is approximately 3 to 1.

The figures of 388 cases showing the relationship of dominant hand and dominant eye.

Squinting Eye	Dominant Eye	Handedness	
O. D.	O. S.	Right	128
O. S.	O. D.	Right	220
O. D.	O. S.	Left	12
O. S.	O. D.	Left	28

Of the 576 cases, congenital Amblyopia was present in 36, pathological Amblyopia in 94, Amblyopia-Ex-Anopsia in 134.

Tabular Resume:

Paralytic	52
Pathological Amblyopia	94
Congenital Amblyopia	36
High Anisometropia	18
Nystagmus	10
Essentially Alternating	42
Neuropathic	20
Post-operative	12
Operation advised (due to wide angle and vertical association)	42
Diseased	3
Moved and were referred (no report obtained)	14
Dismissed (due to development of other pathological conditions)	8
Stopped treatment	20

Of the 205 cases:

187 were definitely successful, while
18 were decidedly unsuccessful.

The average length of time required for completion in 187 successful cases was 26 months.

CONCLUSIONS:

1. That ocular pathology is a major contributing factor in squint.
2. That Amblyopia (congenital or acquired) is a major contributing factor in squint.
3. That hypermetropia is a major contributing factor in squint.
4. That heredity is a major contributing factor in squint.
5. That approximately 20% of all squints are uncorrectable. Either by operative or non-operative treatment.
6. That approximately 3% of all squints are caused by injuries at birth.
7. That operation is indicated in about 20% of squint cases.
8. That non-operative treatment is successful in about 35 to 40% of all squints.
9. That Amblyopia, when associated with a squint in which motility is poor is not a vital factor.
10. That the reduction of such an Amblyopia is not necessary for the elimination of the deviation.
11. That Amblyopia associated with a squint, in which there is good motility, is a vital factor and must be reduced before the deviation can be corrected.
12. That there is no definite relationship between the amount of ametropia and the angle of the squint.
13. That there is no definite relationship existing between the amount of ametropia and the dominant eye.
14. That no one method or technique is 100% successful in all squint correction.
15. That 100% success is unobtainable in all squint correction even by the combined use of all methods (operative, non-operative and psychoanalytical).

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Discussion

DR. W. J. TAIT: Dr. Hall has given a very able and interesting presentation which shows that he has done a lot of work in the field of strabismus. He can talk from a background of considerable experience because strabismus work is all he does. I do not, however, quite agree with him in a few of his conclusions. One is the use of the term tetanus in connection with strabismus. I believe it is an innervational situation and is not, in any sense, an actual sustained muscular tension. It is a matter of the distribution of the tonic reciprocal innervation to the muscles, and regardless of whether the condition is a heterophoria or a heterotropia, there is no difference in the inherent tonicity.

I should also like to have Dr. Hall define the term Amblyopia-Ex-Anopsia.

DR. HALL: There is no question but that there is room for discussion in the use of the term Amblyopia-Ex-Anopsia. It has been used so much that it has become permissible by reason of its use. My interpretation is that it is the condition in which vision has decreased due to non-use or due to a refractive error which prevents the formation of a clear image on the retina.

DR. W. J. TAIT: The reason I have asked the question is that I have never seen a case where there has been Amblyopia from lack of use. For example, I have occluded eyes, prescribed suppression lenses, etc., and I could not possibly develop Amblyopia. In many cataract cases, operative interference has given 20/20 vision even where the eye has been practically blind for years. In these cases there was a long continued lack of use, but no Amblyopia.

DR. FEINBLOOM: I should like to make six points:

First, the difference between true and false alternating, according to Dr. Hall, is that in the true type no change in alternations occurs within a month's treatment, i. e., no simultaneous binocular vision can be obtained. Why, then, call the second class false alternating? Are not these cases examples of a bi-lateral squint? I would suggest that the term "alternating squint" be limited to true alternating squint.

Second, emphasis in the paper is laid on the importance of differential diagnosis, in order properly to treat the squint, i. e., whether the cause is constitutional, mental or pathological. However, it appears to me that the cases showing successful results, in my experience, do not directly relate to these causes. Many cases are corrected without ever finding the causes.

Third, neuropathic divergent squint of long standing should be referred for surgical procedure according to Dr. Hall. My personal experience is that this type of squint, as found in young women under age 30, may be aided by orthoptic treatment. By inducing what may be termed an accommodative myopia we secure cosmetic parallelism even if we rarely attain single binocular vision.

Fourth, workers in Germany have reported favorable results in the use of high prisms for convergence squint in children under three years of age. One group so treated showed definitely more fusion than a control group not so treated. The tests for fusion were made approximately two years after beginning the use of the prism.

Fifth, in view of the repeated advice that operative interference be obtained, may I ask what results are being obtained in surgical interference as far as securing single binocular vision is concerned?

Sixth, I should also like to know what degree of permanence in cosmetic appearance seems to exist following operative procedure?

DR. HALL: Operative treatment, irrespective of what is claimed for it, only gives us about 35% results as far as single binocular vision is concerned. Judging roughly, from my own experience, I think about 85% is a fair estimate of the permanency obtained.

DR. MORROW: I should like to compliment Dr. Hall on the gathering and presentation of this data. Some years ago I had considerable experience in dealing with cases of Amblyopia and I know what a tedious job he has had. However, I am in accord with Dr. Tait in his viewpoint on Amblyopia. I think Amblyopia is usually anything but Ex-Anopsia.

I think we should all have a more definite idea of what we mean by the term. I noted in talking to Dr. Feinbloom that he purposely avoids the use of "Amblyopia" but rather likes to refer to it as subnormal vision.

DR. HALL: This paper has been limited to the treatment of strabismus. We are all, of course, interested in the etiology of subnormal vision.

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COMPULSORY HEALTH INSURANCE

The recent congress of the American Optometric Association was, from many angles, a success, but in reviewing the proceedings of the House of delegates one is at once struck by the fact that one important problem was overlooked. On every hand one finds indications that we are rapidly drifting into some form of State Medicine or what is more properly called Compulsory Health Insurance yet a careful reading of the reports of the deliberations at Toronto fails to reveal even a mention of this important matter.

In marked contrast to this piece of optometric indifference we find, in turning to Cleveland, that the American Medical Association at their annual congress devoted a major portion of their business sessions to a discussion of this matter and we find Dr. N. B. Van Etten, chairman of a special committee on this subject, expressing himself in this manner, "Today we are confronted with an extraordinary situation of the utmost importance to the health and welfare of the American people and to the American medical profession. It is no secret that a considerable number of foreign nations have already established state systems of medical care and that an intensive campaign has been carried on in this country for many years, led by philanthropists, social workers, economists and various foundations, to cause the American medical profession and the

American people to accept a similar type of medical practice. In accordance with the mandate of this House of Delegates, all the facilities of the American Medical Association have been used to oppose this trend and the propaganda in support of it, which has been widely circulated and for which vast sums of money have been, and are being, expended by various interested parties. It is also now well known that the President of the United States, in a recent message, has come forth for the principle of social insurance, with special reference to old age pensions and unemployment insurance."

While Dr. Van Etten and his fellow physicians are largely opposed to any plan of Compulsory Health Insurance they nevertheless do not permit their opposition to socialized medicine to blind them to certain realities, or at least strong possibilities and they are therefore laying the groundwork in such a manner that, should some state plan of health insurance be forced upon them by Congress next January, that they will be in a position to dictate as many of the provisions as possible. While not recommending any plan, the American Medical Association adopted the following set of rules which shall as far as possible serve them as a basis for the conduct of any social experiments that may be contemplated by members of the Congress at Washington or any of the various state legislative bodies. These rules are of great importance to optometry and are as follows:

"First: All features of medical service in any method of medical practice should be under the control of the medical profession. No other body or individual is legally or educationally equipped to exercise such control.

"Second: No third party must be permitted to come between the patient and his physician in any medical relation. All responsibility for the character of medical service must be borne by the profession.

"Third: Patients must have absolute freedom to choose a duly qualified doctor of medicine who will serve them from among all those qualified to practice and who are willing to give service.

"Fourth: The method of giving the service must retain a permanent, confidential relation between the patient and a 'family physician.' This relation must be the fundamental and dominating feature of any system.

"Fifth: All medical phases of all institutions involved in the medical service should be under professional control, it being understood that hospital service and medical service should be considered separately. These institutions are but expansions of the equipment of the physician. He is the only one whom the laws of all nations recognize as competent to use them in the delivery of service. The medical profession alone can determine the adequacy and character of such institutions. Their value depends on their operation according to medical standards.

"Sixth: However the cost of medical service may be distributed,

the immediate cost should be borne by the patient if able to pay at the time the service is rendered.

"Seventh: Medical service must have no connection with any cash benefits.

"Eighth: Any form of medical service should include within its scope all qualified physicians of the locality covered by its operation who wish to give service under the conditions established.

"Ninth: Systems for the relief of low income classes should be limited strictly to those below the "comfort level" standard of incomes.

"Tenth: There should be no restrictions on treatment or prescribing not formulated and enforced by the organized medical profession."

In view of these facts (1) that some form of Compulsory Health Insurance will sooner or later be presented to the American people and (2) that the American Medical Association has already taken steps to firmly entrench themselves behind any plan adopted, it seems necessary to suggest to optometrists that they, through their national organization, arrange a strong offensive group to protect the interests of all optometrists when this matter of health insurance is presented.

It also seems necessary to suggest that the time to act on this critical matter, is now. To achieve any success in matters of this kind one must be well prepared and it is obvious that the initial steps be made with the greatest of care. General optometric policies must be adopted. Surveys of similar work in other countries must be made. England particularly has much to offer us in the way of experience in this matter as the ophthalmic opticians (optometrists) of that country have been struggling with this problem for the last decade. And finally, committees must be appointed and acquainted with their duties, so when the time comes to present the optometrists' side of this question to our legislative bodies, it will be done in a manner so as to safeguard the profession, as well as give the public the greatest possible benefit that can come from us as a professional group. C. C. K.

* * * * *

THE ARONSFELD VARIABLE PRISM TECHNIC OF STATIC SKIAMETRY

In the effort to accomplish the static skiametric test under the most advantageous conditions and with the fullest ciliary relaxation, Aronsfeld[1] has developed a technic which he claims has proven itself satisfactory for some considerable period of time. This technic requires no additional equipment nor does its use consume any appreciable period of time. The author of this new technic presented it before the dele-

[1]Aronsfeld, G. H. Eyesight training and development. The Canadian Optometrist. Vol 16, No. 7, pp. 202-203.

gates at the recent Congress of the American Optometric Association at Toronto.

The technic is carried out as follows: With the phorometer trial frame in place before the patients face the examiner introduces a risley rotary prism before the left eye of the patient in such a way that the base-out and base-in prisms may be brought into use. The examiner next directs the patient's attention to a colored light placed six meters before the patient. The examiner next instructs the patient to watch this colored light and to inform him the moment this light is seen double, at the same time turning the rotary prisms which are before the left eye in such a manner as to cause the prism power to be base-in. As soon as the patient reports seeing two lights, the examiner then reverses the action of the rotary prism until the patient reports that the two lights have again fused into one. Having the patient continue watching the light the examiner next turns the rotary prisms again base-in but only part way toward the breaking or diplopia point. The prisms are left in this position before the left eye of the patient while the skiametric test is being made.

The object Aronsfeld has in mind is to stimulate abduction as much as possible while at the same time maintaining single binocular vision. Aronsfeld believes that this stimulation of the centers controlling the function of abduction will at the same time reflexly inhibit the centers controlling the ciliary and the accommodative functions of the eye. According to certain investigations, Aronsfeld appears to be on fairly sure ground in suggesting this technic, and from the experience he has had with the use of it, the time now seems proper for a broader study of the technic by a large group of optometrists, as it is only in this way that the true value of the technic can be demonstrated.

C. C. K.

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THE VALUE OF ORTHOPTIC TREATMENT WORK IN SQUINT CASES

Most optometrists who are practicing professionally engage in orthoptic treatment work in squint cases. Procedures may vary from practitioner to practitioner but in the main the technics have for their chief aim the development of vision and the restoration of fusion. However, while the technics may vary, the results from case to case vary even more. Cases which are apparently similar in every major particular frequently finish their treatment periods with far different results, one being apparently relieved of the abnormality while the next shows but little if any improvement. Because of this varience in general results, most of us as optometrists have wondered from time to time, just how successful orthoptic treatment work in cases of squint really was, and have wished for some sort of a differential diagnosis which would enable

us to in some manner differentiate those cases which could be successfully treated from those in which little or nothing could be accomplished.

Hall[1] in a paper on the treatment of squint, published in this issue of this Journal, makes the first real attempt to place this important matter on a scientific basis. Hall says: "Not only should the optometrist be able to distinguish those cases which are in need of constitutional treatment, but he must be able to differentiate between operative and non-operative cases and also those in which the assistance of a psycho-analyst is needed." Hall then proceeds to lay the ground work for this important diagnostic matter.

However, as far as the general value of these treatment technics is concerned, taking squint cases as they come, it remained for Guibor[2] to conduct a series of experiments which gives us no little encouragement. Guibor, in the effort to determine just what was being accomplished by means of his orthoptic treatment technics in these cases of squint, gathered together a group of 78 cases of non-paralytic squint. This group was then divided into two portions. The first, a group of 38 cases, was treated in the usual manner, without orthoptic training. The second, a group of 40 cases, was given regular orthoptic training. In this manner Guibor had a group of control cases, the average progress of which he could compare with those cases under treatment.

The results achieved by Guibor were as follows: In Group 1, fusion and depth perception were developed in 20 per cent of the cases. Improvement in the angle of squint of over 5 degrees was obtained in 25 per cent, and complete correction of the squint occurred in 7.5 per cent. In Group 2, (the treated patients) binocular macular perception was obtained in all cases at some time during the treatment and fusion in 99 per cent. Complete correction of the squint was obtained in 50 per cent of the cases with glasses and in 42.1 per cent without glasses. The improvement in vision was seldom marked. More improvement might have been seen in younger patients subjected to prolonged monocular occlusion of the fixing eye as a preliminary to orthoptic training. In 7.5 per cent of the cases, although fusion was obtained, the angle of squint was not improved during the treatment. Guibor suggests that the value of orthoptic training can be realized only by the observation of patients treated under systematic supervision by persons especially interested in such training. Special clinics offer distinct advantages in many cases. The length of each period of training is important. The treatment, which varies from fifteen minutes to two and one-half hours, should be continued as long as the patient is improving. The attention of the average patient can be kept for one hour by proper variation of charts

[1]Hall, R. M. The Non-Operative Treatment of Strabismus. Vol. VIII. American Academy of Optometry. Published by the American Journal of Optometry. Minneapolis, Minn. 1934. pp. 84-116.

[2]Guibor, G. P. Possibilities of Orthoptic Training. Arch of Oph. March, 1934.

and procedures. Training at home is a distinct aid, but is not essential to obtain results. Most of the patients in this group by Guibor had no such training. Three patients with alternating squint had fusion, one showing a slight improvement in the angle of anomaly. Accordingly, Guibor does not agree with Worth and Peter that a congenital absence of fusions exists in these cases, so that they are unsuitable for training. There seemed to be no age limit in these cases beyond which it was impossible to develop fusion. Some patients between two and four years of age co-operated sufficiently for training and for accurate observation in the control group. Patients showing considerable amblyopia were capable of developing fusion when using a stereoscope. C. C. K.

* * * * *

OPTOMETRIC CLASSICS

"Name the ten most important books written by optometrists during the first quarter of the twentieth century, using as a basis for your judgment the effect each book had on the profession as a whole?" That question or request covers a lot of territory and resulted in a survey of optometric literature just conducted by the writer.

To be effective, the subject matter of a technical book must be one in which a large portion of the members of a profession must be interested and in addition to this the book must fairly cover its subject in a clear understandable way. In addition to this the author must have the ability to arouse his readers in such a manner that they will favorably react to his suggestions as it in this manner only that advancement is made. In addition to these things the book must have been published in sufficient quantities so as to become available to all members of the profession and the unit cost of the book must be reasonably low.

Keeping these things in mind the survey was started, and it soon developed that optometric literature divided itself into four major subdivisions. These subdivisions are: (1) Ocular Refraction, (2) Ophthalmic Lens Optics, (3) Optometric Sociology, and (4) The Treatment of Binocular Imballances. It, therefore, became essential to not only value each book as an individual part of the literature of our profession but it also became essential to give it a grading when compared to similar books in its same subdivision. This naturally made the task doubly difficult and when limited to ten books, lays one open to all sorts of criticism. However, as a start, I have selected the following ten books which I believe to be well worthy of the name of Optometric Classics. That others could and should be added to this list, there is no doubt, and any reader may make up his own suitable list of the ten most important books published between the years 1900 and 1925, should he disagree with my deductions.

Group One. *Ocular Refraction.* In this group I have placed just half of the total number of books to be selected. As refraction is the basic

fundamental work of optometrists, I feel that this group should contain at least the names of five books. Selecting these was by no means easy and no doubt many readers will disagree with my choice, however, in each case I felt that the author of the books chosen had, in such a definite manner influenced the profession as a whole, as to justify my choice, and as each of these books is a well written technical work they are included as follows:

Ocular Refraction. Group One. (Five Books).

Book No. 1—Dynamic Skiametry by Andrew Jay Cross (1911).

Book No. 2—Visual Optics and Sight Testing by Lionel Laurance (1920).

Book No. 3—Dynamic Skiametry by Charles Sheard (1920).

Book No. 4—Ophthalmometry by E. LeRoy Ryer (1925).

Book No. 5—Ocular Accommodation by Charles Sheard (1920).

Group Two. *Ophthalmic Lens Optics.* In this group I have placed just one book. This was written by a man so pre-eminently a master of his subject that the choice was easy. The author of this book has done more, in my opinion, than any other individual in laying the ground work upon which the profession has reared itself.

Ophthalmic Lens Optics. Group Two. (One Book).

Book No. 6—Ophthalmic Lenses by Charles F. Prentice (1907).

Group Three. *Optometric Sociology.* In this group I have placed two books. While it is true that neither of these books are entirely technical, both have presented the profession so much of real and lasting value, and both were written at a time when the profession needed the impatus that only these authors seemed able to give, that I, without hesitation, include them in this list of the ten most important optometric books. The professional development, so noticeable in optometry during the past 15 years, is largely traceable to the foundations laid down by the following authors:

Optometric Sociology. Group Three. (Two Books).

Book No. 7—Building Optometry by Eugene G. Wiseman (1921).

Book No. 8—Hygiene the Optometrist Ought to Know by Frederic A. Woll (1921).

Group Four. *The Treatment of Binocular Imballances.* In this group I have placed two books. While neither of these books would be considered complete today, these works were, nevertheless, the forerunners of modern orthoptic treatment technics and these books did much to stimulate interest in these finer optometric therapeutic measures at a time when most optometrists were content to sit back and correct manifest ocular refractive errors only. Both of these authors were conservative and by means of their writings did much to broaden the scope of modern day refractive procedure.

The Treatment of Binocular Imballances. Group Four. (Two Books).

Book No. 9—Oculo-Prism Treatment by Samuel H. Robinson (1924).

Book No. 10—Cross Eyes by Henry R. Higley (1923).

It is interesting to note that the professional development kept pace with the development in the literature of the profession. Starting with a technical foundation of mathematics and physics the science of optometry developed through better refractive technics. These in turn awakened the desire for a better type of professional practice which in turn emphasized the need for orthoptic treatment work. To say that these authors were entirely responsible for these evolutionary changes would be an exaggeration but it is nevertheless true that much of our rapid development is due to the care and effort to which they dedicated their work, and it is for this reason that we can now, in my opinion, with safety, evaluate these ten books as optometric classics. C. C. K.

BOOK NOTICES

EXTERNAL DISEASES OF THE EYE. Donald T. Atkinson, M.D., Consulting Ophthalmologist to the Santa Rosa Infirmary and the Nix Hospital, San Antonio, Texas. Published by Lea & Febiger, Washington Square, Philadelphia, Pa. 704 pages, 479 illustrations, $7.50, 1934.

This large volume by Atkinson deals with the external diseases of the eye and the lesions of the skin in the neighborhood of the eye. In this manner the author has developed a correlation between ophthalmology and dermatology that is of decided importance. The book is very well illustrated both by actual photographs of patients and also by unique photographs of life size wax models made by the author. These are very well done and constitute but one of the many fine points of this reference book.

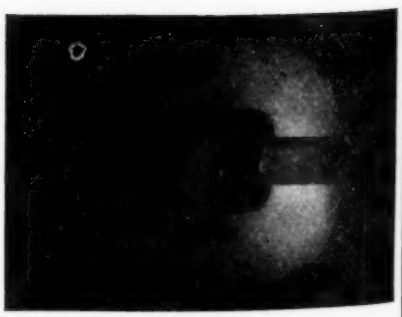
The sections dealing with ptosis spectacles, transillumination, and the hygiene of the eye will be of particular interest to optometrists. In his chapter dealing with ptosis spectacles the author illustrates a device in which the ptosis prop is made of zylonite attached to the frame by means of a resilient spiral spring thus affording a certain degree of movement to the lids. This is a somewhat different arrangement from that suggested by Neill before the American Academy of Optometry in 1931, as Neill used a rigid platium ptosis prop bar, also with success.

Dr. Donald T. Atkinson, the author of this book should not be confused with Dr. Thomas G. Atkinson, ophthalmologist of Chicago, a writer and speaker very favorably known to optometric audiences. However this new book by Donald T. Atkinson should introduce *him* to many optometrists as he has written a work of marked value to all refractionists. C. C. K.

A Modern age demands

"Hold on there,

young fellow. Glasses aren't made for that sort of treatment." Maybe not, but Loxit mountings are built to help withstand unexpected stress which so often causes rimless breakage.

Strain in a lens

is a frequent contributing cause of breakage. Polarized light reveals (left) the strain present in an ordinary screw mounting and (right) the minimum of strain with Loxit screwless mounting.